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C9162

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NPG REPORT NO. 1082

U. S. NAVAL PROVING GROUND DAHLGREN, VIRGINIA	
REPORT NO. 1082	
HYPERVELOCITY PROJECTILES	
29th Partial Report	
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STATIC TESTS OF 3 1/2" 176 HYPERVELOCITY PROJECTILES VERSUS AIRCRAFT	
Task	Assignment
FINAL Report	NPG-Re3b-211-2-53
Copy No.	Classification
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NPG REPORT NO. 1082

U. S. NAVAL PROVING GROUND  
DAHLGREN, VIRGINIA

Twenty-ninth Partial Report  
on  
Hypervelocity Projectiles

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Final Report  
on  
Static Tests of 3 1/2/1 1/2 Hypervelocity Projectiles  
Versus Aircraft

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Project No.: NPG-Re3b-211-2-53  
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Date: JAN 26 1953

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NPG REPORT NO. 1082

Static Tests of 3 1/2" 1 1/2" Hypervelocity Projectiles  
Versus Aircraft

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PART A

SYNOPSIS

1. This test was conducted to determine the fragment velocity and blast fragment damage produced by a 3 1/2" 1 1/2" hypervelocity projectile, HBX-1 loaded, statically detonated in the proximity of an aircraft.
2. The hypervelocity projectiles detonated in the engine, fuselage (just aft of the engine), and wing panel near the fuselage joint of BTD and SB2C aircraft caused severe damage. The results for the five (5) rounds tested ranged from an immediate kill to a kill in 5 minutes. The average median fragment velocity was 3640 feet per second.

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Static Tests of 3#2/1#6 Hypervelocity Projectiles  
Versus Aircraft

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Static Tests of 3 1/2/1 1/6 Hypervelocity Projectiles  
Versus Aircraft

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PART B

INTRODUCTION

1. AUTHORITY:

This test was authorized by reference (a) and conducted under Task Assignment No. NPG-Re3b-211-2-53, reference (b).

2. REFERENCES:

- a. NOL Conf ltr NP/NOL/X1-1 (3506) WG:VBR:dk Ser 02312 of 23 October 1952
- b. BUORD Conf ltr Re3b-RS:mt NP9 Ser 42220 of 18 July 1952

3. OBJECT OF TEST:

This test was conducted to determine the fragment velocity and blast fragment damage produced by a 3 1/2/1 1/6 hypervelocity projectile, HBX-1 loaded, statically detonated in the proximity of BTB and SB2C aircraft.

4. PERIOD OF TEST:

- |                                     |                  |
|-------------------------------------|------------------|
| a. Date Project Letter              | 23 October 1952  |
| b. Date Necessary Material Received | 30 October 1952  |
| c. Date Commenced Test              | 25 November 1952 |
| d. Date Test Completed              | 26 November 1952 |

PART C

DETAILS OF TEST

5. DESCRIPTION OF ITEM UNDER TEST:

3 1/2/1 1/6 hypervelocity projectiles, 19 1/2" long, 1 1/6" maximum outside diameter with wall thickness varying from 0 1/2" to 0 1/4". All eight (8) projectiles were loaded with HBX-1 explosive. The total weight with the modified Mk 27 nose fuze was 5.4 ± .1 lbs and the explosive weight was 505 grams. Drawings of the projectile assembly and body are shown in Figures 1 and 2.

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Static Tests of 3½/1½6 Hypervelocity Projectiles  
Versus Aircraft

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## 6. DESCRIPTION OF TEST EQUIPMENT:

- a. BTD aircraft (Rounds 1, 2, and 3)
- b. SB2C aircraft (Rounds 4 and 5)
- c. 30' radius velocity arena (Rounds 6, 7, and 8)

## 7. PROCEDURE:

## a. Aircraft Tests:

The 5 rounds tested versus aircraft were placed with their center of gravity located approximately 6 inches inside the skin of the aircraft.

## b. Velocity Tests:

Each projectile was placed vertically in the center of a 30 foot radius arena with its center 6 feet above ground level and initiated from the top by a special engineers blasting cap. Fragment velocities were obtained by the usual high speed photographic technique. The camera used was a 35mm Fastax. Fragment velocities obtained are the mean velocities over the first thirty (30) feet of travel of beam spray (polar angle 80° - 110°) fragments.

## 8. RESULTS AND DISCUSSION:

## a. Aircraft Tests:

The 3½/1½6 hypervelocity projectile was very effective against the BTD and SB2C aircraft when detonated in engine, wing, and fuselage locations. The detailed damage data are listed as follows:

(1) Round 1 versus BTD engine, projectile entry at 135° from aircraft nose (0°) and 5' to rear of nose. The damage consisted of 3 cylinders broken up, 4 cylinders damaged, exhaust pipes blown out, skin around engine blown off, oil lines cut, and cable lines cut. The engine, if running, would have stopped within five (5) minutes and would have been on fire almost instantaneously. Control of the aircraft after the hit would be questionable. A photograph of this engine is shown in Figure.3.

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Static Tests of 3#2/1#6 Hypervelocity Projectiles  
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(2) Round 2 versus BTD wing panel, nose-on attack with projectile entry normal to leading edge, into wing panel fuel cell about 1 foot outboard from panel joint on fuselage. The damage consisted of opening up the fuel cell and wing panel, and tearing of the forward spar in the vertical and horizontal plane. This spar lost all of its structural strength since the vertical tear was complete. Eight (8) fragment hits were noted in the cockpit. The panel joint to the fuselage was badly weakened. If this plane had been flying when hit, it would have lost the wing panel and caught fire, and the pilot would have been injured or dead. A photograph of the wing panel is shown in Figure 4.

(3) Round 3 versus BTD engine, projectile entry at 45° from airplane nose (0°) and 1-1/2 feet to the rear of the propeller. The damage consisted of 2 cylinders broken up, 1 cylinder damaged, 10" x 5" hole in motor block, cable lines cut, and skin around motor blown off. Damage to the operating aircraft was similar to that for Round 1. A photograph of this engine is shown in Figure 5.

(4) Round 4 versus SB2C fuselage, side on attack with entry 90° from aircraft nose (0°) and 3 feet forward of cockpit. Almost all of the instruments are in the location selected for this hit. The damage consisted of almost complete destruction of the instruments, cut cables, cut electrical leads, fuselage skin around cockpit blown off, all cockpit shielding blown off, and numerous holes in the cockpit seat. The immediate result of this type of hit on a SB2C in flight would be loss of control and a dead pilot. The chance of a fire is not considered great. A photograph of the SB2C fuselage is shown in Figure 6.

(5) Round 5 versus SB2C engine, projectile entry at 90° from aircraft nose (0°) and 3 feet to the rear of the propeller. The damage consisted of skin around the engine blown off, cables cut, exhaust pipes blown off, and two (2) damaged cylinder heads. This plane if hit in flight would probably have caught fire and remained operable for about 5 minutes. A photograph of this engine is shown in Figure 7.

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Static Test of 3.2/1.6 Hypervelocity Projectiles  
Versus Aircraft

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b. Fragment Velocity Tests:

Detailed fragment velocity data are listed in Table I. The results are summarized as follows:

<u>Round No.</u>	<u>Median Fragment Velocity (ft./sec.)</u>
6	3610
7	3620
<u>8</u>	<u>3680</u>
3 round average	3640

PART D

CONCLUSIONS

9. It is concluded that:

a. The hypervelocity projectiles detonated in the engine, fuselage (just aft of the engine), and wing panel near the fuselage joint of the BTD and SB2C aircraft caused severe damage. The results for the five (5) rounds tested ranged from an immediate kill to a kill in 5 minutes.

b. The projectile has an average median fragment velocity of 3640 feet per second.

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b. Fragment Velocity Tests:

Detailed fragment velocity data are listed in Table I. The results are summarized as follows:

<u>Round No.</u>	<u>Median Fragment Velocity (ft./sec.)</u>
6	3610
7	3620
8	3680
3 round average	3640

PART D

CONCLUSIONS

9. It is concluded that:

a. The hypervelocity projectiles detonated in the engine, fuselage (just aft of the engine), and wing panel near the fuselage joint of the BTD and SB2C aircraft caused severe damage. The results for the five (5) rounds tested ranged from an immediate kill to a kill in 5 minutes.

b. The projectile has an average median fragment velocity of 3640 feet per second.

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Static Tests of 3!2/1!6 Hypervelocity Projectiles  
Versus Aircraft

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The tests upon which this report is based were conducted by:

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Fragmentation Division  
Terminal Ballistics Department

This report was prepared by:

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Commander, Naval Proving Ground



E. A. RUCKNER  
Captain, USN  
Ordnance Officer  
By direction

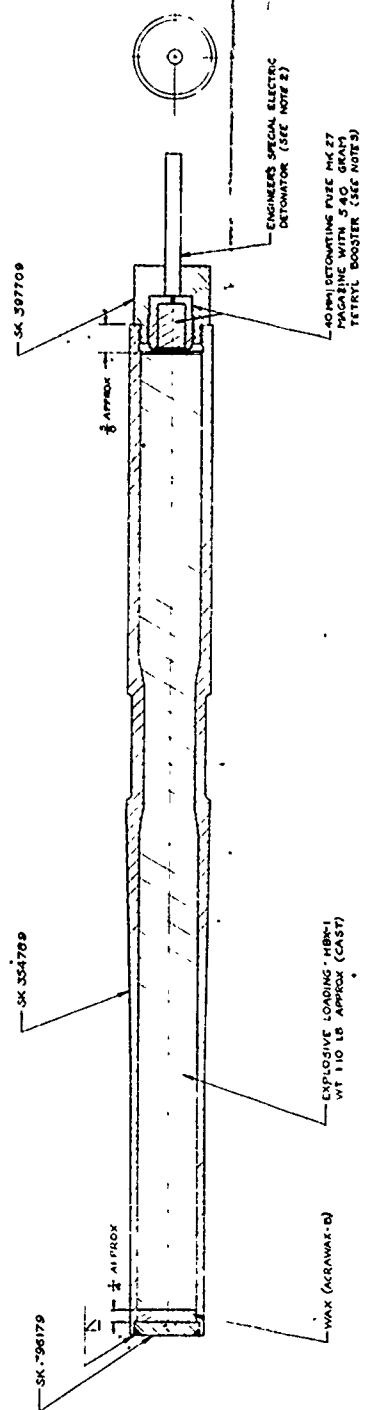
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1352

MOBILE ROCKET FOR 100 LB. 40 CAL. GUN

REV.	DATE	BY	CHKD.	DESCRIPTION
1				
2				
3				
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5				
6				
7				
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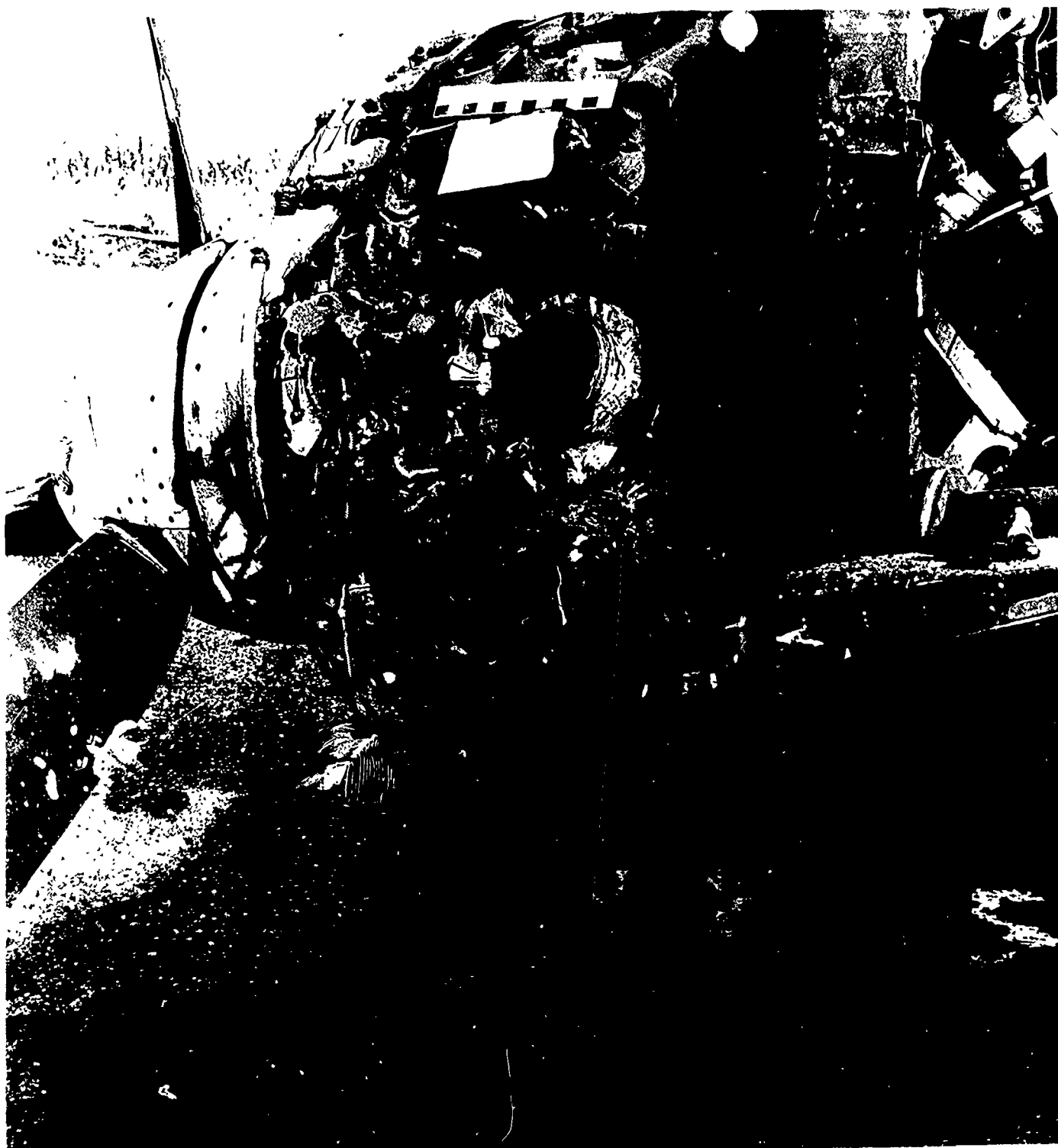
- NOTES:
1. COAT INTERIOR SURFACES WITH CAVITY PAINT (EPA JAN-P-450) PRIOR TO EXPLOSIVE LOADING.
  2. ASSEMBLE DETONATOR IN HOLDER AS FINAL STEP IN FIELD INSTALLATION, HOLD WITH TAPE AS REQUIRED.
  3. BOOSTER MAGAZINE POSITION IN HOLDER MUST BE ADJUSTED TO BRING BOOSTER IN CONTACT WITH EXPLOSIVE CHARGE.



REV.	DATE	BY	CHKD.	DESCRIPTION
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

SK 35





NP9-51821 25 November 1952  
Round 1, 3"2/146 Projectile versus BTD Engine.

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Figure 3



NP9-51822

25 November 1952

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Round 2, 3 1/2 x 1 1/4 Projectile versus BTD Wing Panel

FIGURE 4



NP9-51823  
Round 3, 3"2/1"6 Projectile versus B7D Engine.

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Figure 5

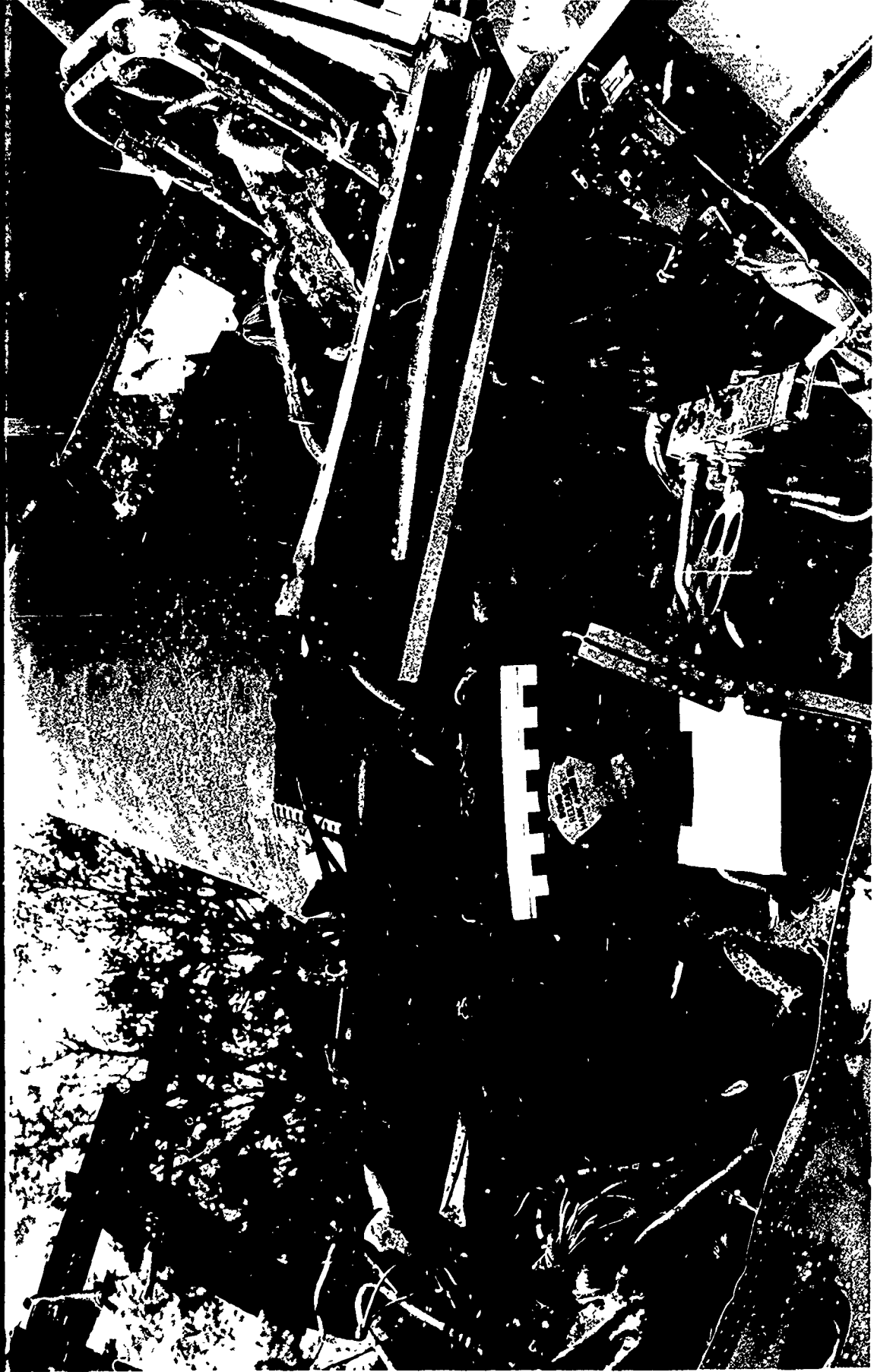


NP9-51824

25 November 1952

round 4, 3"2/1"6 Projectile versus SL2C Fuselage forward of cockpit.  
FIGURE 6

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NP9-51825

25 November 1952  
Round 5, 3"2/1"6 Projectile versus SB2C Engine.

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Figure 7



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Static Tests of 3 1/2/1 1/6 Hypervelocity Projectiles  
Versus Aircraft

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TABLE I

FRAGMENT VELOCITY DATA

30 Ft. Radius Arena

Date Fired: 11/26/52

35mm Fastax Camera

3150 Frames per sec.

Rd. 6 3 1/2/1 1/6 Hypervelocity Proj.

Filler: HBX-1

Total Weight: 5.4 lbs.

Filler Weight: 505 gms.

<u>Frame in Which Hit Occurred</u>	<u>No. Fragments</u>	<u>Velocity (f/s)</u>
22	3	4300
23	7	4110
24	4	3940
25	10	3780
26	4	3630
27	6	3500
28	9	3380
29	8	3260
30	5	3150
31	1	3050
32	2	2950
34	2	2780
Median		3610
Average		3570

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Static Tests of 3 1/2" 1 1/2" Hypervelocity Projectiles  
Versus Aircraft

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TABLE I (Continued)

30 Ft. Radius Arena	Date Fired: 11/26/52
35mm Fastax Camera	3100 Frames per sec.
Rd. 7 3 1/2" 1 1/2" Hypervelocity Proj.	Filler: HBX-1
Total Weight: 5.4 lbs.	Filler Weight: 505 gms.

<u>Frame in Which Hit Occurred</u>	<u>No. Fragments</u>	<u>Velocity (f/s)</u>
21	2	4430
22	1	4230
23	8	4040
24	9	3880
25	10	3720
26	5	3580
27	7	3440
28	8	3320
29	8	3210
30	6	3100
31	1	3000
32	2	2910
Median		3620
Average		3570

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Static Tests of 3 1/2/1 1/6 Hypervelocity Projectiles  
Versus Aircraft

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TABLE I (Continued)

30 Ft. Radius Arena

Date Fired: 11/26/52

35mm Fastax Camera

3100 Frames per sec.

Rd. 8 3 1/2/1 1/6 Hypervelocity Proj. Filler: HBX-1

Total Weight: 5.4 lbs.

Filler Weight: 505 gms.

<u>Frame in Which Hit Occurred</u>	<u>No. Fragments</u>	<u>Velocity (f/s)</u>
21	3	4430
22	8	4230
23	7	4040
24	8	3880
25	6	3720
26	10	3580
27	5	3440
28	7	3320
29	6	3210
30	5	3100
31	4	3000
33	2	2820
Median		3680
Average		3630

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